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## SPINOZA'S USE OF THE "EUCLIDEAN FORM" OF EXPOSITION

THE TIME which is marked with a revolt against authority and tradition, with an awakening of reflective thinking and careful criticism; the time in which the state—slowly but surely—takes the place of the church as an organ of civilization; with the striving toward equal rights and justice to all mankind; the time in which absolute lordship, slavery and serfdom gradually disappear is also marked by a revival of interest in nearly all branches of mathematics, science and philosophy. Great contributions are made to theoretical mathematics in algebra, theory of equations and trigonometry—as early as the last half of the sixteenth century, and in the beginning of the seventeenth century some new processes in geometry were invented. In applied mathematics, there seems to have been no progress, even up to the end of the sixteenth century, since the time of Archimedes. Statics and hydrostatics remained in much the same state in which he had left them, while a science of dynamics did not exist. It was then that Descartes developed a new system of geometry and Spinoza casts Descartes' and his own philosophy into a geometrical form.

Descartes' influence upon Spinoza in the field of metaphysics is a well-known fact, and it is reasonable to suppose that he exerted an influence upon him in the field of methodology. The monistic tendency of Descartes, which will be pointed out in another paper, and also the tentative



thought of accepting the method of mathematics wholly as a method to be used in philosophy, he claimed only that by improving the mathematical method it could revolutionize philosophy and put it on a sound basis. As to Descartes' actual use of geometrical form,<sup>4</sup> it was only a tentative sketch in which he expressed his doubts as to its success.<sup>5</sup> Consequently we may conclude that the influence of Descartes upon Spinoza in the field of methodology—as has been said above—does not lie in the acceptance of the geometrical form into which Euclid cast the properties of space, nor in the improved method of algebra and geometry which Descartes employed, but in the misinterpreted method of Descartes, that is, the purely deductive method of algebra and geometry.

A contemporary of Descartes, Thomas Hobbes, exerted a great influence upon Spinoza. The marked influence of Hobbes upon Spinoza is shown in his treatment of political and social theory, and no doubt he was influenced by Hobbes as to the place of geometry among the sciences. Hobbes accepts the new natural science of Copernicus and Galileo,<sup>6</sup> whom he regards as the founders of science. Geometry is the only sure and universal discipline, all knowledge of reality is rooted in it.<sup>7</sup> Although Spinoza makes no direct reference to Hobbes in this connection, nevertheless, being familiar with Hobbes' writings, he must have been influenced by his conception of mathematics.

The certainty and simplicity of theorems in pure mathematics, the belief of Descartes and Hobbes in the universality of mathematics; all these considerations were important factors in convincing Spinoza that deduction is the only true method. But that does not answer the question

<sup>4</sup> From the reply to the second objection (Latin, 1670, p. 85-91).

<sup>5</sup> Preface to the *Principles of Descartes' Philosophy* (H. H. Britan, tr. 1905), p. 3.

<sup>6</sup> The beginning of *De Corpore*.

<sup>7</sup> *Elementa philosophica de cive* (Molesworth ed., vol. 1, ch. 1, p. 3).

which we raised; what were the motives which prompted Spinoza to employ the form of deduction found in Euclid's text books?

From the end of the sixteenth century, there had been a gradual rise of interest in Euclidean Geometry in all parts of the world. In England, Roger Bacon said that toward the close of the thirteenth century the definitions and a few of the theorems in geometry were studied by some pupils of Oxford.<sup>8</sup> About 1570, Sir Henry Savile began to lecture at Oxford on Greek geometry, and in 1619, Briggs at Cambridge on Euclid. In 1665, Isaac Borrow, at Cambridge, prepared a complete edition of Euclid, while Gow says that "from 1660 to 1730 . . . was the period during which the study of Greek geometry was at its height."<sup>9</sup> The same is true of all other centers of learning in Europe. Euclid is the prime figure of interest. Just as Aristotle was the infallible authority of the middle ages, so Euclid was in the seventeenth and the beginning of the eighteenth century. At that time, we find Robert Simson saying,<sup>10</sup> in order to prove the infallibility of Euclid, that the mistakes in the proofs of the theorems found in Euclid's elements were not due to Euclid but to his translators. It must be remembered in this connection that a critical study of geometry was only begun in the latter part of the nineteenth century.

This great success of Euclidean geometry, and the first appearance of his elements in print at the time of Spinoza, must have had a magnetic influence upon the scholars of the day. But have we any reasons to believe that Spinoza himself looked upon the rigorous logical form of geometry as *the infallible type of reasoning*? Did the thoughts of Spinoza move in the fashion laid down by Euclid? Or are

<sup>8</sup> Ball, *Mathematics at Cambridge*, 1889, p. 3.

<sup>9</sup> Gow, *History of Greek Geometry*, 1884, p. 208.

<sup>10</sup> Simpson's, *First Addition of Euclid*. See also, Introduction to Heath's *Euclid*.

there any other reasons which would account for his use of the geometrical form? In order to answer this important query, let us examine the works of Spinoza.

The geometrical demonstration of the second part of the "Principles of Descartes' Philosophy," was written by Spinoza for a pupil whom he tutored, and it was only by the persuasion of some of his friends that Spinoza wrote the first part of the Principles, in order that both parts might be published. He permitted this to be published upon the condition that his friend, Ludwig Meyer, would explicitly state in the preface of the book that "he does not acknowledge all the opinions there set forth as his own inasmuch as he holds the exact contrary,"<sup>11</sup> but that it is only a faithful presentation of Descartes' philosophy. From the above facts we must admit that Spinoza did not employ the geometrical form of reasoning because he thought he could thus present an irrefragable body of truth. He did not use this form because of its infallibility. The proofs of Descartes' doctrines are as rigorous logically as his own in the Ethics, and yet Spinoza admits, at the time of the publication of the book that he holds the exact contrary of that proven in the Principles.<sup>12</sup> In fact, in the appendix to the book,<sup>13</sup> Spinoza gives his own views of God, not using the geometric method at all. Furthermore, in all of his other works, with the single exception of his Ethics, geometrical form of deduction is not employed, and even in the Ethics it is a very common thing to notice that Spinoza takes relief in an elaborate note in order to get away from the geometrical frame—e. g., the appendix to Part Four—and as a matter of fact, Spinoza is at his best in

<sup>11</sup> Spinoza to Oldenburg (Letter IX, Elwes tr.).

<sup>12</sup> The difference between Spinoza's axioms and definitions and Descartes', does not wholly account for Spinoza's disagreement with some of the fundamental doctrines of Descartes. Spinoza does accept some of Descartes' axioms but does not always accept the theorems which he has proven in the *Principles of Descartes* to follow from them, e. g., in the demonstration of prop. 21, part I.

<sup>13</sup> *Cognitata Metaphysica*.

these notes. The reader of the fourth part of his *Ethics* can not help but be conscious that the form in which the material is cast is bothersome and superficial; as Spinoza himself often says, such-and-such is self-evident, and really can be taken as axiomatic, but nevertheless he goes on and proves its validity by using the rigorous deductive method.

How can we reconcile the fact that Spinoza applied the geometrical method to error as well as to truth, to doctrines which were directly opposed to his belief as well as to principles which he firmly believed? Why were his friends so anxious for the publication of the "Principles of Descartes' Philosophy"? If he thought the geometrical method is infallible, why did he not employ it in his other books?

As has been pointed out, his first use of this method was in order to instruct a pupil of his in the principles of Descartes' philosophy. His aim was to put before the boy the simplest and clearest possible exposition of Descartes. It was a pedagogical aim, and not a philosophical one, which prompted Spinoza to use the geometrical form, in order that the pupil whom he was instructing might more easily comprehend the principles which Descartes developed and not the truth or falsity of his conclusion. *This method was not employed as a method of proof but for its pedagogical advantages.* The logical coherence of geometrical reasoning was the best from a pedagogical standpoint because of its conformity to the demands of the thinking mind, especially for the facility it offers for reviewing the bases of any theorem.

In the age where geometrical reasoning was at its highest, the appearance of the philosophy of the most respected thinker, Descartes, in the geometrical form was of very great advantage. All learned men were discussing geometry, and the casting of philosophy into a geometrical form would add greatly to the understanding of it. So we find Spinoza urged by his friends to publish the *Principles of*

Descartes' Philosophy." As Ludwig Meyer states in the preface, "granted, however, that truth may be established beyond all chance of doubt by these two methods [speaking of Descartes' method of reflective induction or inference and deduction] still they do not have equal value, for many plainly unlearned in mathematical knowledge and so wholly ignorant of the method by which such truth is discovered [first part of Descartes' method<sup>14</sup>] and by which it is set in order [second part of Descartes' method] are not only unable to teach the truth to others, but are unable to follow it for themselves. Whence it happens that many who have made his opinions and dogmas only a matter of memory, carried away by some thoughtless attack or influenced by the authority of others, have defamed the name of Descartes, and when a discussion of these things arises, since they cannot demonstrate anything, garrulously repeat what has always been ascribed to the Peripatetic Philosophy. Wherefore, in order that this state of affairs might be improved, I have often desired that some one . . . may remold in synthetic order the 'philosophy of Descartes' and demonstrate it in the more familiar form of geometry."<sup>15</sup> With this interpretation of Spinoza's use of geometrical form, the apparent discrepancy between the method employed and his own views upon some of the fundamental conclusions of Descartes' philosophy disappear.

Also, it becomes clear why Spinoza did not employ the geometrical mode of procedure in all of his books. And it also becomes clear why he did employ it in his *Ethics*. The *Ethics* was written in a geometrical form for the same reasons that his first book had been written. His last book presented his constructive philosophy and he felt it important that it be not misunderstood as Descartes' philosophy

<sup>14</sup> Concerning the fact that Descartes method consists of two parts, which will be pointed out in another paper.

<sup>15</sup> Preface to the *Principles of Descartes' Philosophy*, H. H. Britan tr., 1905, p. 3 and 4.

had been. Consequently, in spite of a certain antipathy pointed out above, he put his last work in a form in which it could be most easily and clearly understood. Spinoza's thought, however, did not move in the fashion in which the material in the book is presented, as is now clearly evident. For Spinoza, truth is not geometrical, but rational; the proof of it is that of ground and consequence, cause and effect. "The knowledge of an effect depends on and involves the knowledge of a cause."<sup>18</sup>

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<sup>18</sup> *Ethica*, Axiom 4. A similar case in the history of science is found in Newton's employment of geometrical proof to cover up his results which he has obtained by the method of fluxional calculus, because his critics would not understand this new method and would fail to realize its truth. "He accordingly cast the *Principles* into geometrical form, and thus presented it to the world in a language which all men could then understand." Ball's *A Short History of Mathematics*, p. 266.

Spinoza's *Ethics* appeared in 1677, while Newton's *Principles* was published in 1686. Both of these men writing about the same time found it expedient to present their important contributions in the geometrical form.

Referring to Euclid's arrangement of geometrical theories, Mach says: "For the purpose of instruction, the simplest principles, those most easily gained and apparently free from doubt and contradiction, are placed at the beginning, and the remainder based upon them." Mach, *Space and Geometry*, p. 112, McCormack tr.